Memorandum

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From:	Ben Tarrant/Peter Cuppit/Danielle O'Toole	**At:**	SLR Consulting Australia Pty Ltd
Date:	1 February 2022	**Ref:**	680.10421.90060-M05-v1.2 Construction Water.docx
Subject:	Rum Jungle Rehabilitation - Stage 2A Detailed Engineering Design Construction Water		

1 Preliminary

The assignment of construction water will be in accordance with EIS requirements.

The existing surface water environment has been described in detail in the Rum Jungle EIS. The purpose of surface water treatment activities is to ensure that:

- All waters captured or managed on site are are treated to satisfy the Locally Derivived Water Quality Objectives (LDWQO) before leaving the Site to the Eastern Branch Finniss River (EBFR); and
- There is a low risk of an uncontrolled overflow of pit waters to the EBFR during the Construction phase.

The information provided herein outlines the assignment of the water to facilitate the construction of Rum Jungle rehabilitation works.

2 Water Management Description

The design principles of the construction water management system are to be consistent with the Rum Jungle Remediation EIS.

The water management system will consist of a closed water system that captures runoff from active construction areas and groundwater flows. Water captured will be treated for construction re-use that may comprise of the following:

- the construction of the Waste Storage Facilities (WSFs),
- dust suppression,
- irrigation; and/or
- release to the Eastern Branch Finniss River (EBFR), upstream of gauging station GS8150200.

Outlined in the following headings are critical components of the water management system.

2.1 Water Treatment Plant

A Water Treatment Plant (WTP) will be required to treat both ground and surface waters of varying degrees of quality and quantity to respond to the strong seasonality of the Site and the various remediation tasks required over the course of the Rum Jungle project. All excess flows generated on the incremental catchments of the open pits, seepage intercept systems (SiS), and groundwater from recovery bores will report to a WTP. The WTP will be temporary in nature. The water quality output from this WTP is to satisfy the Locally Derived Water Quality Objectives (LDWQO). A reference groundwater extraction and WTP design involving a flexible extraction network and collection system and a 'Geco' high-density sludge Acid Mine Drainage (AMD) treatment process is detailed in the WTP design report and technical specification (Ref: 680.10421-90060-R01-v0.3 and 680.10421-90060 WTP Technical Specification-R02-v0.2). A suitably qualified Contractor will be required to build and operate a WTP to produce an effluent that satisfies the LDWQO for approximately ten years or until such time as the proponent agrees with the Regulator to cease abstraction and treatment.

2.2 East Branch Finniss River

The East Branch Finniss River (EBFR) is the primary river system that transects the Rum Jungle Mine Site. Flows from the river trend west then, northwest, and are diverted around major mining works via the Eastern Branch Diversion Channel (EBDC). The diverted flows run to the south of the Main and Intermediate Pits before returning to the natural flow path of the EBFR to the northwest of the Site.

One of the key objectives of the Project is to restore water quality objectives within the East Branch of the Finniss River and ensure that there is a low risk of an uncontrolled overflow of pit waters to the EBFR during construction. The LDWQO (Hydrobiology, *Compliance LWDQOs*, January 2022) are presented below in **Table 1.**

Water captured within the Rum Jungle water management system can only be released to the EBFR during the wet season.

Table 1 Locally Derived Water Quality Objectives (LDWQO)

Analyte	Zone 2 Project LDWQOs (mg/L) (Hydrobiology, 2022)
Arsenic	0.14
Aluminium	0.236
Cadmium	0.0043
Cobalt	0.089
Copper	0.0602
Iron (2+ and 3+)	0.300
Manganese	0.759
Nickel	0.1304
Magnesium	86.6
Lead	0.0129
Zinc	0.2105
EC (µS/cm)	2,985
Sulphates	1,192

2.3 Main Pit

The Rum Jungle Main Pit is located in the central mine reach along the pre-mining course of the EBFR.

At present, the waters within the Main Pit are stratified with varying degrees of water quality.

The Main Pit will be the main water supply for construction, dust suppression, and irrigation. The Main Pit lake will be isolated from the EBFR flows during constructin; however, it will be used as a large raw water pond and will receive contaminated effluents from waste rock, site runoff, seepages, and tailings ponds.

Water from the Main Pit will be extracted by a pumping system operated by the WTP. Water sourced from the Main Pit may be used for placement of the waste rock within the WSFs will not require treatment and can be directly sourced from the pit. Water for dust suppression and irrigation will require treatment and will be sourced from the WTP.

Parallel to supplying the Rum Jungle construction water, the Main Pit will also be sub-aqueously backfilled with waste rock materials. During backfilling, displaced Main Pit water is to be treated by the WTP. Prior to beginning backfill works, approximately 422ML of Pit water will need to be removed to create the operating freeboard.

2.4 Intermediate Pit

The Intermediate Pit is located to the west of the Main Pit.

The Intermediate Pit operating water level will be lowered by 8.5m at commencement of construction and discharged directly to the EBFR. This will ensure the hydraulic profile of the surrounding groundwater drains to the pit rather than the EBFR during construction.

During construction if required, water from the Intermediate Pit will be extracted by a floating pumping system operated by the WTP. The recharge from surrounding groundwater is expected to triple the current Copper and Sulphate laods requiring treatment prior to release into the EBFR.

2.5 Construction operating levels in pits

The following freeboards (**Table 2**) are to be accommodated as detailed in the EIS to prevent overtopping of the pits during a significant flood event.

Table 2 Construction operating levels in the pits

Pit	Outlet Culvert Weir Level (m AHD)	Construction Operating Level (m AHD)	Drawdown from dry season level (m)
Intermediate	57.82	49	8.5
Main	59.95	58	1.5

2.6 Groundwater

Water quality objectives in the EBFR are to be achieved by extracting contaminated groundwater from strategic locations across the Site via a groundwater seepage interception system (SiS) and releasing treated water to the environment over a period of approximately 10 years.

Groundwater is to be extracted and treated from five strategic locations over the Rum Jungle Site:

1. Main WRD (East);
2. Main WRD (West);

3. Intermediate WRD (North);
4. Heap Leaching Area; and
5. Old Tailings Stockpile Area.

In addition to the groundwater extraction, four surface sump wells are to be established at the sag point of the toe drain of the Main and Intermediate WRDs. The sumps are to intercept and capture first flush flows and transfer the solution to the WTP.

2.7 Surface Flows and Runoff

Flows across the Rum Jungle Site are split between the EBDC and the Main Pit; the majority of flow passes through the EBDC. Water from the Main Pit flows to the Intermediate Pit via a channel that roughly follows the original course of the EBFR. Outflow from the Intermediate Pit to the EBFR occurs near the western boundary of the mine site, with the combined flows from the open pits and EBDC continuing in a north-easterly direction via the natural course of the EBFR.

3 Construction Water Receptors

The following are considered major construction water receptors.

3.1.1 Waste Storage Facilities

The two new Waste Storage Facilities (WSFs) labelled as East WSF (EWSF) and West WSF (WWSF) are proposed for the relocation and consolidation of waste rock and contaminated soils currently present across the Rum Jungle Mine Site (Drawing **680.10421-WSF-SERIES-D01 to D13**).

Construction of the WSFs will generally comprise:

- Bottom-up construction methodology;
- Upon placement, waste rock will be lime-treated and then compacted in controlled layers (each nominally 0.5 m) to increase density, water residence time and saturation, and create an alkaline environment;
- The WSF will be built up vertically over a number of cells to allow part or all of the cover system to be constructed prior to the Wet season for each cell;
- Construct outer surfaces to final geometry within the placement cycle to expedite final surfaces available for revegetation covers;
- Construction of cover systems progressively alongside the waste rock lifts and progressive revegetation of cells and cover system surfaces to reduce rainfall infiltration during construction and to stabilise the outer surfaces as rapidly as possible; and
- Dyson's WRD material, which is generally non-acid forming (NAF) to very low PAF, will be placed as an oxygen scavenging layer over the PAF and beneath the formal cover system.

The waste storage facilities will require construction water at all stages of development to ensure adequate compaction is achieved in accordance with WSF specifications.

Construction water used for the placement of waste rock, including waste rock used for oxygen scavenging layers can be untreated so long as runoff pathways and seepage are controlled and do no enter the EBFR.

Water used in the placement of the low permeability clay layers and growth medium layers as part of the WSF cover systems is to be treated water meeting LDWQO requirements.

3.1.2 Haul Roads

Haul Roads will require construction water to ensure adequate compaction is achieved in accordance with Haul Road specifications. The haul road construction water used shall be treated to meet or exceed the LDWQO requirements.

3.1.3 Dust Suppression

The impact on hydrological processes due to altered surface water flow regimes during the Main Pit backfilling operations will be moderated by the maximum use of treated water in the dust suppression and construction processes onsite. The dry time of year correlates to the highest water demand period for dust suppression and construction because all work areas will be subject to low humidity, warm conditions and high equipment movement rates. The availability of this treated water offsets the need to abstract from clean water sources for the purpose of dust suppression and construction.

Dust suppression water shall satisfy the LDWQO requirements.

4 Estimated Flow Rates

4.1 WTP Inflow Sources

The following tables summarise the approximate inflow rates to the WTP from the groundwater bores, seepage interception systems, groundwater recharge and surface water sources. The flow rates have been levelled over 24 hours and for the 5 month wet season and 7 month dry season. This is considered a reasonable estimate considering the large storage volumes involved.

All groundwater pumps are variable speed enabling a variation in extraction within any zone to respond to the sample bore monitoring results. The seepage interception system is designed to capture the first flush surface contaminants and will therefore only operate intermittently. The overall system is flexible but has been sized to comfortably operate within this range.

Table 3 Water Treatment Plant Inflow Rates From Groundwater and SiS Sources

Source	Dry season flow rate (kL/day)	Wet season flow rate (kL/day)
Groundwater and Seepage Interception Sources		
Main WRD (east), 6 groundwater bores	518.4	1,036.8
Main WRD (east), SIS sump pump	86.4 – 518.4	86.4 – 1,036.8
Main WRD (west), 3 groundwater bores	259.2	518.4
Main WRD (west), SIS sump pump contingency	86.4 – 259.2	86.4 – 518.4
Intermediate WRD (north), 4 groundwater bores	345.6	691.2
Intermediate WRD (north), SIS sump pump contingency	86.4 – 345.6	86.4 – 691.2
Heap Leach, three groundwater bores	259.2	518.4
Old tailings, one groundwater bore	86.4	172.8
Subtotal Groundwater & SIS	**Approximately 1,468.8 kL/day**	**Approximately 2,937.6 kL/day**

Runoff captured in the WSF sediment basins would be pumped to the WTP in a controlled manner and therefore could be delayed during heavy rain events. These rates have been based on an average during the construction period.

Table 4 Surface Water and Groundwater Recharge Rates to the WTP

WTP Input	Dry season flow rate (kL/day)	Wet season flow rate (kL/day)
Groundwater Ingress and Surface Water Sources		
Rainfall contribution to the Main Pit	86.4	1,123.2
Evaporation from the Main Pit (8-hours)	-201.6	-172.8
Rainfall contribution to the Intermediate Pit	86.4	691.2
Evaporation from Intermediate Pit (8-hours)	-57.6	-57.6
Groundwater recharge into the Intermediate Pit during construction	1,555.2	2,678.4
Groundwater recharge into the Main Pit	0	0
Waste Storage Facility sediment basins	86.4	1,296.0
Subtotal Groundwater & SIS	**Approximately 1,555.2 kL/day**	**Approximately 5,558.4 kL/day**

As the WTP will operate on a 24hour basis and the Main Pit backfilling on an 8hour day shift, the size of the treatment facility can be substantially reduced by the temporary storage of the displaced Main Pit water and treatment after hours. The magnitude of the WTP has been designed to facilitate a backfilling rate of 100L/s during the wet season. A greater backfilling rate is possible during the dry season due to the absence of rain induced sources freeing up the spare capacity for Main Pit displacement.

Table 5 Backfilling Rates

WTP Input	Dry season flow rate (kL/day)	Wet season flow rate (kL/day)
Displaced water during backfilling		
Estimated Main Pit water displacement rate = backfill rate (8 hour average duration)	Approximately 5,126.4 kL/day	Approximately 2,880 kL/day

4.2 Outflows

The WTP will require a treatment capacity of 100L/s operating on a 24 hour basis to accommodate the range of sources and achieve a day shift backfilling rate of 100L/s during the wet season.

Table 6 WTP Output

WTP Output	Maximum dry season flow rate (kL/day)	Maximum wet season flow rate (kL/day)
WTP treatment rate		
High pH treatment strem	5,184 kL/day	5,184 kL/day
Neautral pH treatment stream	8,640 kL/day	8,640 kL/day

Treated water will be required for dust suppression and WSF construction during days where the prevailing weather will generate airborne droplets. Untreated Main Pit water will be used on the WSF on calm days to reduce the volume of water needed to be treated. The following table summarises the expected range of water demand during a day shift (8 hr day) over the wet and dry seasons during the construction period. Surplus treated water would be irrigated to evaporate or discharged to the EBFR.

Table 7 Outflow Demand

WTP Output	Dry season flow rate (kL/day)	Wet season flow rate (kL/day)
Outflow Demand		
Minimum construction water for dust suppression	864.0	720.0
Maximum construction water for dust suppression	1,152.0	1,152.0
Haul Road Construction	259.2	144.0
Waste Storage Facility Construction	230.4	144.0
Irrigation/East Branch Finniss River	~3,694.4 - 7,150.4	~3,896.0 - 7,352.0

5 Water Management Plan

The draft Water Management Plan (WMP) presented in the EIS is to be updated prior to the commencement of Stage 3 works and implemented throughout the project.

6 Execution

6.1 Treated Water for Construction

Treated water adhering to LDWQO will be held in Pond 1 (Drawing 680.10421.WTP.D02) of the Water Treatment Plant and made available for transport via tank T32. The tank of 100kL has been designed to fill four water trucks in quick succession rapidly. A submersible pump mounted in a sag in pond 1 would top up the tank. An 8kW submersible with a duty of 40L/s at 10m head would refill the tank in 40 minutes.

6.2 Untreated Water for Construction

Untreated water shall be used on waste rock only. Untreated water shall be used for dust suppression (waste rock exposures) and WSF construction (waste rock only) in preference to treated water during low wind conditions. Treated water shall be used in WSF waste rock placement when the prevailing weather has the potential to generate airborne droplets from water trucks.

Automation of an untreated water truck fill station is required to eliminate the exposure to contaminated Main Pit water during water truck refills. The mechanical arrangement (Ref: Drawing 680.10421.WTP.D02) shall consist of a bank mounted diesel end suction pump with a duty of 90L/s at 25m head (to fill water truck in 5 minutes) and a screened floating intake to draw water from the Main Pit. A pressure switch on an accumulator tank mounted on the 216 m long DN315, PN10 (Pressure capacity of 10 bars), High-Density Polyethylene (HDPE) rising near the pump shall activate and deactivate the diesel pump. A drop in pressure at the fill station caused by opening the release valve will create a drop in pressure in the accumulator tank necessary to activate the pump. Closure of the valve will enable the accumulator tank to re-pressurise and trip the pump.

The fill station located in the truck fill layby shall consist of an elevated DN250 DICL (Ductile Iron Cement Lined) or Victaulic gooseneck with a short length of flex hose at the discharge point with dimensions to suit the adopted water truck fill point. The gooseneck shall contain a Bluetooth® activated butterfly valve mounted on the downward arm interlocked with a magflow meter and a controller (mounted on the rising leg of the gooseneck). The actuated butterfly valve shall be activated by the driver via Bluetooth® to start the fill, and the magflow meter totalise the volume of water until a preset volume is reached (normally 26,000L), which will send a signal to close the actuator on the butterfly valve. A one-way air valve is required at the crest of the rising limb of the gooseneck to prevent air pocket control issues.

6.3 Irrigation and Release to EBFR

Treated water not needed for construction activities, in excess of the WTP storage capacity, adhering to LDWQO will either be used for either irrigation or released to the EBFR. Quantities and quality of water released to EBFR will be measured, recorded and auditable. Records will be provided to the Superintended on a weekly basis along with downstream monitoring results during periods of discharge and 30 minutes following termination of discharge. The monitoring station will be GS8150200 located downstream of the steel access bridge to the west of the site crossing EBFR.

7 Measurement and Payment

- Payment for construction water is be included within placement of waste rock unit rates.
- Payment for dust suppression shall fall under Earthworks Enabling costs and be provided on a day rate basis.
- Payment for irrigation is to be paid on a day rate basis.

Checked/ Authorised by: DOT